**Leukemia Drug Kills T-cells, Spares Immunity**

A study published this January by dermatologists at Brigham and Women’s Hospital may transform the way physicians approach treatment for leukemic cutaneous T-cell lymphoma (L-CTCL).

L-CTCL is a cancer that affects a type of white blood cell known as the T-cell and causes damage to the skin and other organs. Once diagnosed, patients with the disease generally have a poor prognosis—with an average of three years to live.

BWH Department of Dermatology chairman Thomas S. Kupper and BWH assistant professor of dermatology Rachael A. Clark led a study which explored the efficacy of a new drug regimen to treat L-CTCL. Their report, which was published in Science Translational Medicine, showed that a low dosage of the drug Campath, or alemtuzumab, combats L-CTCL by selectively targeting cancer cells. In addition, they found that the low-dose Campath allows for treatment without increasing their patients’ risk of acquiring infections.

“Standard chemotherapies and alemtuzumab can put L-CTCL into partial or complete remission, but the disease is not curable and eventually will recur,” Kupper wrote in an emailed statement to The Crimson.

Much of Clark and Kupper’s work involved understanding Campath’s interaction with the immune system, specifically T-cells. Though previously believed to kill all T-cells and B-cells—the cells at the frontline of the immune response—the researchers found that Campath actually only kills T-cells that enter the blood stream.

“The amazing thing about Campath is that it kills all the T-cells in the circulation but it doesn’t kill the T-cells in the skin,” said Clark. “They [the T-cells in the skin] are protected from the medication because they don’t circulate.”

Through the course of the study, Clark and Kupper administered Campath to patients with L-CTCL. They found that the patients improved most significantly when given low doses of the drug. In order to study the physiological effects of the drug, the researchers then took blood samples and skin biopsies. Upon examination, they found that T-cells in the skin remained greatly unaffected as the patients improved.

“We sampled their skin through skin biopsies [and] found large numbers of T-cells in the skin,” Clark said. “Here was the drug that was supposed to kill all the T-cells and yet there they were.”

With this finding, Clark and Kupper were led to further investigate the nature of these unaffected skin T-cells. Their research demonstrated for the first time that there were two types of T-cell populations in humans and validated extensive research on the migratory patterns of T-cells within tissues.

“This is still a very novel concept—a sort of paradigm shift in the way we view the immune system—but our work and that of others suggest that we need to pay very close attention to what is happening in tissues,” said Kupper.

With the publication of these ground-breaking findings, the scientists wished to acknowledge the patients who participated in their research.

“The real heroes of this work are our patients, who in spite of this devastating disease willingly and often enthusiastically donated their blood and skin biopsies for this work,” said Kupper.

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* Leukemia is a [cancer](http://www.medicinenet.com/script/main/art.asp?articlekey=13931) of the blood cells.

* While the exact cause(s) of leukemia is not known, risk factors have been identified.

* Leukemi as are grouped by how quickly the disease develops (acute or chronic) as well as by the type of blood cell that is affected (lymphocytes or myelocytes). The four main types of leukemia include acute lymphocytic leukemia (ALL), chronic lymphocytic leukemia (CLL), acute myelocytic leukemia (AML), and chronic myelocytic leukemia (CML).

* People with leukemia are at significantly increased risk for developing infections ,[anemia](http://www.medicinenet.com/script/main/art.asp?articlekey=2015), and bleeding. Other symptoms and signs include [easy bruising](http://www.medicinenet.com/script/main/art.asp?articlekey=24714), [weight loss](http://www.medicinenet.com/script/main/art.asp?articlekey=24749), [night sweats](http://www.medicinenet.com/script/main/art.asp?articlekey=57394), and unexplained [fevers](http://www.medicinenet.com/script/main/art.asp?articlekey=361).

* The diagnosis of leukemia is supported by findings of the [medical history](http://www.medicinenet.com/script/main/art.asp?articlekey=3768) and examination, and examining blood and [bone marrow](http://www.medicinenet.com/script/main/art.asp?articlekey=7201) samples under a microscope.
* Treatment of leukemia depends on the type of leukemia, certain features of the leukemia cells, the extent of the disease, and prior history of treatment, as well as the age and health of the patient.

* Most patients with leukemia are treated with [chemotherapy](http://www.medicinenet.com/script/main/art.asp?articlekey=7778). Some patients also may have [radiation therapy](http://www.medicinenet.com/script/main/art.asp?articlekey=7782) and/or bone marrow transplantation.

* There is no known way to prevent leukemia.

* The prognosis of leukemia depends upon several factors, including the patient's age, the type of leukemia, and the extent to which the cancer has spread.

## Early Symptoms of Leukemia: An Introduction

Like all blood cells, [**leukemia cells**](http://leukemia.emedtv.com/leukemia-cells/leukemia-cells.html) travel through the body. Depending on the number of abnormal cells and where these cells collect, patients with [**leukemia**](http://leukemia.emedtv.com/leukemia/leukemia.html) may have a number of early symptoms of leukemia. People with [**acute leukemia**](http://leukemia.emedtv.com/acute-leukemia/acute-leukemia.html) are more likely to have early symptoms of leukemia than those with[**chronic leukemia**](http://leukemia.emedtv.com/chronic-leukemia/chronic-leukemia.html).

## Early Symptoms of Leukemia: Acute Leukemia

Acute leukemia includes such forms of the disease as [**acute lymphocytic leukemia**](http://leukemia.emedtv.com/acute-lymphocytic-leukemia/acute-lymphocytic-leukemia.html)(ALL) and acute myeloid leukemia ([**AML**](http://leukemia.emedtv.com/aml/aml.html)). In acute leukemia:

* The blood cells are very abnormal
* The blood cells cannot carry out their normal work
* The number of abnormal cells increases rapidly.

Therefore, early symptoms of leukemia are more common in people who have acute leukemia.

For AML and ALL, early symptoms of leukemia can include:

* Fever
* Fatigue
* Frequent infections
* Painless lumps in the neck, underarm, stomach, or groin
* Pain or feeling of fullness below the ribs
* Paleness or pallor
* Easy bleeding or bruising
* Loss of appetite
* Tiny red spots (called petechiae) under the skin
* [**Bone**](http://bones.emedtv.com/bone/bone.html) or joint pain.

## What Are Leukemia Cells?

[**Leukemia**](http://leukemia.emedtv.com/leukemia/leukemia.html) cells are abnormal, immature cells produced by blood-forming tissue (such as bone marrow). These cells are named based on the cells that they affect -- lymphoid or myeloid cells. Each of these [**types of leukemia**](http://leukemia.emedtv.com/leukemia/types-of-leukemia.html) cells will be discussed in this article.

## Understanding Normal Blood Cells and Leukemia Cells

Before talking about leukemia cells, it may be helpful to understand normal blood cells and how they form. Blood cells form in the bone marrow, which is the soft material in the center of most bones. Normally, the bone marrow begins by producing immature blood cells, called stem cells and blasts. As these blood cells mature, they form into one of three types of mature blood cells:

* Red blood cells that carry oxygen and other materials to all tissues of the body
* White blood cells that fight infection and disease.
* Platelets that help prevent bleeding by causing blood clots to form.

Mature blood cells are created from one of two types of stem cells -- lymphoid stem cells or myeloid stem cells. As lymphoid stem cells mature, they become lymphoid blasts (also known as lymphoblasts), then lymphocytes, and finally white blood cells. As myeloid stem cells mature, they become myeloid blasts (also known as myeloblasts), then myelocytes (also called granulocytes), and finally either white blood cells, red blood cells, or platelets (depending on the type of granulocyte).

In people with leukemia, the bone marrow produces abnormal cells -- either abnormal lymphoid cells or myeloid cells. When abnormal lymphoid cells are created, it is known as lymphocytic leukemia (or lymphoblastic leukemia). When abnormal myeloid cells are created, it is known as myeloid leukemia (or myelogenous leukemia).

There are four common types of leukemia based on the cells formed, along with the aggressiveness of the cancer. These types include:

* [**Chronic lymphocytic leukemia**](http://leukemia.emedtv.com/chronic-lymphocytic-leukemia/chronic-lymphocytic-leukemia.html) ([**CLL**](http://leukemia.emedtv.com/leukemia/cll.html))
* [**Chronic myelogenous leukemia**](http://leukemia.emedtv.com/chronic-myelogenous-leukemia/chronic-myelogenous-leukemia.html) ([**CML**](http://leukemia.emedtv.com/leukemia/cml.html))
* [**Acute lymphocytic leukemia**](http://leukemia.emedtv.com/acute-lymphocytic-leukemia/acute-lymphocytic-leukemia.html) (ALL)
* Acute myeloid leukemia ([**AML**](http://leukemia.emedtv.com/aml/aml.html)).

## An Introduction to the Types of Leukemia

The common types of [**leukemia**](http://leukemia.emedtv.com/leukemia/leukemia.html) differ based on how quickly the disease progresses (chronic versus acute) and by which blood cells are affected (lymphoid versus myeloid).

## Chronic Leukemia Versus Acute Leukemia

Leukemia can be chronic (gets worse slowly) or acute (gets worse quickly).

**Chronic Leukemia**

In the early stages of [**chronic leukemia**](http://leukemia.emedtv.com/chronic-leukemia/chronic-leukemia.html), the abnormal blood cells can still do their work, which means that people with chronic leukemia may not have any symptoms. However, as chronic leukemia progresses and the number of [**leukemia cells**](http://leukemia.emedtv.com/leukemia-cells/leukemia-cells.html) in the blood rises, symptoms will appear.

**Acute Leukemia**

In [**acute leukemia**](http://leukemia.emedtv.com/acute-leukemia/acute-leukemia.html), the blood cells are very abnormal, the blood cells cannot carry out their normal work, and the number of abnormal cells increases rapidly. Acute leukemia progresses quickly.

## Lymphoid Versus Myeloid

The types of leukemia will also depend on the type of white blood cell that is affected. Leukemia can arise in lymphoid cells or myeloid cells. Leukemia that affects lymphoid cells is called lymphocytic leukemia. Leukemia that affects myeloid cells is called myeloid leukemia or myelogenous leukemia.

Based on the aggressiveness of the disease and the blood cells that are affected, there are four common [**leukemia types**](http://leukemia.emedtv.com/leukemia/leukemia-types.html), which include:

* [**Chronic lymphocytic leukemia**](http://leukemia.emedtv.com/chronic-lymphocytic-leukemia/chronic-lymphocytic-leukemia.html) ([**CLL**](http://leukemia.emedtv.com/leukemia/cll.html))
* Chronic myeloid leukemia ([**CML**](http://leukemia.emedtv.com/leukemia/cml.html))
* [**Acute lymphocytic leukemia**](http://leukemia.emedtv.com/acute-lymphocytic-leukemia/acute-lymphocytic-leukemia.html) (ALL)
* Acute myeloid leukemia ([**AML**](http://leukemia.emedtv.com/aml/aml.html)).

[**Hairy cell leukemia**](http://leukemia.emedtv.com/hairy-cell-leukemia/hairy-cell-leukemia.html) is another type of leukemia, but it is rare.

## What Is Acute Leukemia?

[**Leukemia**](http://leukemia.emedtv.com/leukemia/leukemia.html) is cancer that starts in blood-forming tissue, such as the bone marrow, and causes large numbers of abnormal blood cells to be produced and enter the bloodstream. Each year, leukemia is diagnosed in about 29,000 adults and 2,000 children in the United States. Leukemia is either chronic (gets worse slowly) or acute (gets worse quickly).

In acute leukemia:

* The blood cells are very abnormal
* The blood cells cannot carry out their normal work
* The number of abnormal cells increases rapidly
* The disease progresses quickly.

## Understanding Normal Blood Cells

Blood cells form in the bone marrow. [**Bone**](http://bones.emedtv.com/bone/bone.html) marrow is the soft material in the center of most bones. Immature blood cells are called stem cells and blasts. Most blood cells mature in the bone marrow and then move into the blood vessels. Blood flowing through the blood vessels and heart is called the peripheral blood.

## Acute Leukemia and Cells

In people with acute leukemia, the bone marrow produces abnormal white blood cells. These abnormal cells are [**leukemia cells**](http://leukemia.emedtv.com/leukemia-cells/leukemia-cells.html). At first, leukemia cells function almost normally. However, in time, they may crowd out normal white blood cells, red blood cells, and platelets, which makes it hard for blood to do its work.

## What Is Chronic Leukemia?

[**Leukemia**](http://leukemia.emedtv.com/leukemia/leukemia.html) is cancer that starts in blood-forming tissue and causes large numbers of blood cells to be produced and enter the bloodstream. Each year, about 29,000 adults and 2,000 children in the United States are diagnosed with leukemia. Leukemia is either chronic (gets worse slowly) or acute (gets worse quickly). In early stages of chronic leukemia, the abnormal blood cells can still do their work, and people with chronic leukemia may not have any symptoms of the cancer. However, as the cancer slowly progresses, [**symptoms of chronic leukemia**](http://leukemia.emedtv.com/chronic-leukemia/symptoms-of-chronic-leukemia.html) will appear as the number of [**leukemia cells**](http://leukemia.emedtv.com/leukemia-cells/leukemia-cells.html) in the blood rises.

## Understanding Normal Blood Cells

Blood cells form in the bone marrow. [**Bone**](http://bones.emedtv.com/bone/bone.html) marrow is the soft material in the center of most bones. Immature blood cells are called stem cells and blasts. Most blood cells mature in the bone marrow and then move into the blood vessels. Blood flowing through the blood vessels and heart is called the peripheral blood.

## Chronic Leukemia Cells

In people with chronic leukemia, the bone marrow produces abnormal white blood cells, which are leukemia cells. At first, leukemia cells function almost normally. However, in time, they may crowd out normal white blood cells, red blood cells, and platelets, which makes it hard for blood to do its work. This may result in infection, anemia, and easy bleeding.

## Research on Leukemia: An Introduction

Doctors all over the country are conducting many [**types of leukemia**](http://leukemia.emedtv.com/leukemia/types-of-leukemia.html) research studies in which people take part voluntarily. This research has already led to advances, and scientists are continuing to search for new methods of treatment and supportive care for people with [**leukemia**](http://leukemia.emedtv.com/leukemia/leukemia.html).

## Current Areas of Leukemia Research

Scientists conducting research on leukemia are testing:

* New biological therapies
* New anticancer drugs, doses, and treatment schedules
* Various drugs
* Combinations of drugs, biological therapy, radiation therapy, and stem cell transplantation.

## Research on Chemotherapy With Stem Cell Transplant

New types of treatment are being tested in leukemia research, including chemotherapy with stem cell transplant. This is a method of administering chemotherapy and replacing blood-forming cells destroyed by the [**leukemia treatment**](http://leukemia.emedtv.com/leukemia/leukemia-treatment.html). In this treatment, stem cells (immature blood cells) are removed from the blood or bone marrow of the patient or a donor and are frozen and stored.

After the chemotherapy treatment is completed, the stored stem cells are thawed and given back to the patient through an infusion. These reinfused stem cells grow into (and restore) the body's blood cells.

## An Overview of Treating Leukemia

[**Leukemia**](http://leukemia.emedtv.com/leukemia/leukemia.html) treatment options vary based on the type of leukemia that a person has. Factors that may influence the treatment options include:

* The type of leukemia (see[***Types of Leukemia***](http://leukemia.emedtv.com/leukemia/types-of-leukemia.html))
* The patient's age
* Whether [**leukemia cells**](http://leukemia.emedtv.com/leukemia-cells/leukemia-cells.html) are present in the cerebrospinal fluid
* Whether the leukemia has been treated before
* Certain features of the leukemia cells
* The patient's symptoms and general health.

In general, leukemia treatment options can include:

* Chemotherapy
* Other drug therapy
* Biological therapy
* High-dose chemotherapy with stem cell transplant
* Donor lymphocyte infusion
* Surgery.

Choosing the most appropriate treatment is a decision that ideally involves the patient, the family, and the healthcare team.

## Statistics on Leukemia: 2006 Estimates

The American Cancer Society estimated that 35,070 men and women (20,000 men and 15,070 women) would be diagnosed with[**leukemia**](http://leukemia.emedtv.com/leukemia/leukemia.html) in 2006, and 22,280 men and women would die of the disease during the year.

## Leukemia Statistics: Age-at-Diagnosis Figures

From 1998-2002, the median age at[**leukemia diagnosis**](http://leukemia.emedtv.com/leukemia/leukemia-diagnosis.html) was 67 years. The percentages of people diagnosed with the disease based on age were as follows:

* 11.4 percent were diagnosed under age 20
* 5.2 percent between 20 and 34
* 5.9 percent between 35 and 44
* 9.7 percent between 45 and 54
* 13.9 percent between 55 and 64
* 20.5 percent between 65 and 74
* 23.2 percent between 75 and 84
* 10.1 percent at 85+ years of age.

## Leukemia Statistics: Deaths

From 1998-2002, the median age at death from leukemia was 74 years. The percentages of people who died from the disease based on age were:

* 3.3 percent died under age 20
* 3.5 percent between 20 and 34
* 3.9 percent between 35 and 44
* 6.7 percent between 45 and 54
* 11.8 percent between 55 and 64
* 23.4 percent between 65 and 74
* 31.1 percent between 75 and 84
* 16.4 percent at 85+ years of age.

The age-adjusted death rate for leukemia was 7.6 per 100,000 men and women per year. These rates are based on people who died in 1998-2002 in the United States. Death rates by race and sex are shown in the following table.

|  |  |  |
| --- | --- | --- |
| **Race/Ethnicity** | **Men** | **Women** |
| All races | 10.2 per 100,000 men | 5.8 per 100,000 women |
| Caucasian | 10.4 per 100,000 men | 6.0 per 100,000 women |
| African American | 8.9 per 100,000 men | 5.4 per 100,000 women |
| Asian/Pacific Islander | 5.3 per 100,000 men | 3.2 per 100,000 women |
| American Indian/Alaska Native | 5.1 per 100,000 men | 3.0 per 100,000 women |
| Hispanic | 6.6 per 100,000 men | 4.3 per 100,000 women |

## Statistics on Leukemia Survival Rates

[**Leukemia**](http://leukemia.emedtv.com/leukemia/leukemia.html) survival rates can be calculated by different methods for different purposes. The survival rates presented here are based on the relative survival rate. The relative survival rate measures the survival of the cancer patients in comparison to the general population to estimate the effect of the disease. The overall five-year relative survival rate for 1995-2001 was 47.6 percent.

The five-year relative survival rates by race and sex were:

* 49.6 percent for Caucasian men
* 48.4 percent for Caucasian women
* 39.2 percent for African American men
* 36.9 percent for African American women.

## Leukemia Statistics: Lifetime Risk

Based on rates from 2000-2002, 1.27 percent of men and women (or 1 in 79 men and women) born today will be diagnosed with leukemia at some point during their lifetime. These statistics are referred to as the lifetime risk of developing cancer. Sometimes, it is more useful to look at the probability of developing leukemia between two age groups. For example, 0.48 percent of men will develop the disease between their 50th and 70th birthdays, compared to 0.28 percent of women.

## Statistics on Leukemia Prevalence Rate

On January 1, 2002, in the United States there were approximately 189,865 men and women alive who had a history of leukemia -- 106,434 men and 83,431 women. This prevalence rate includes any person alive on January 1, 2002, who had been diagnosed with the disease at any point prior to January 1, 2002, any person with active disease, and those who had been cured of their disease.